8. Many opinions can be explored. Students should be encouraged to listen to other viewpoints. Most important, students should recognize that the answer to the question is found not within the discipline of science but that of ethics. The question illustrates the limits of using a scientific paradigm for problem solving.

13.4 THE PERIPHERAL NERVOUS SYSTEM

Section 13.4 Questions

(Page 435)

1. Both are composed of sensory and motor neurons. The sensory-somatic system responds to the external environment, and the autonomic system responds to the internal environment.
2. The two divisions of the autonomic nervous system are the sympathetic and parasympathetic systems. The sympathetic system prepares the body for stress, whereas the parasympathetic system restores normal body conditions. Sympathetic nerves have short preganglionic and long postganglionic nerves; parasympathetic nerves have long preganglionic and short postganglionic nerves. Both release acetylcholine from the preganglionic nerve, but the postganglionic nerves of the sympathetic system release norepinephrine, whereas the postganglionic nerves of the parasympathetic system release acetylcholine.
3. The vagus nerve is a major cranial nerve and is part of the parasympathetic nervous system. Branches of the vagus nerve regulate the heart, bronchi, liver, pancreas, and digestive tract.
4. The sympathetic system contains short preganglionic neurons and long postganglionic neurons, and the parasympathetic system contains long preganglionic and short postganglionic neurons.
5. (a) Ephedrine should not be taken by someone with high blood pressure. The release of norepinephrine increases the heart rate and stroke volume (the amount of blood pumped out of the heart at each beat). This will cause an increase in blood pressure.
   (b) Muscles would contract but would not receive a second impulse.

CHAPTER 13 SUMMARY

Make a Summary

(Page 440)

1. Students' answers will vary but should include all the important vocabulary from this chapter.
2. Students' answers will likely be more detailed, contain appropriate vocabulary, and reflect any revisions to previous misconception.

CHAPTER 13 REVIEW

(Pages 441–443)

Part 1

1. C
2. B
3. A
4. C
5. D
6. B
7. C
8. C

9. 3, 2, 4, 1
10. 2, 3, 1, 1
11. 3, 4, 5, 7

Part 2

12. The nerves of individuals who have a higher threshold level are not as easily activated. This means that it takes an impulse of greater intensity to activate these sensory neurons; hence, the person tends not to feel pain as easily.
13. Neuron X is an excitatory neuron. Its neuron transmitter causes the depolarization of neuron Y, making it easier to reach threshold level. Neuron W is an inhibitory neuron. Its neuron transmitter causes the hyperpolarization of the resting membrane Y, making it more difficult to achieve threshold level.
14. Without acetylcholine being produced, postsynaptic membranes would not be depolarized. Nerve transmission would be severely inhibited because although sensory nerves would respond to stimuli, motor neurons could not be excited. Walking, sitting, and other movements that require motor nerves could not occur. Even breathing movements would stop.
15. The cerebellum
16. The force of muscle contraction is 4 N. The all-or-none response indicates that once the neuron has been excited, it experiences force with the same speed and intensity.
17. The threshold level is 20 mV.
18. Neuron B releases an inhibitory neurotransmitter.
19. An action potential in neuron C will not cause a response in D because sufficient neurotransmitter chemicals are not released. However, if an action potential in C and another excitatory neuron, such as A, are combined, then an action potential in neuron D will be produced.
20. If a leg had been severed, but the cell body of the sensory neuron remained intact, the neuron would continue to send information to the central nervous system (CNS). The area of the CNS that was stimulated by the nerve was for the severed area of the leg. Although the section of the leg was removed, the sensory neuron continues to indicate that the area was irritated.
21. Myelin-associated glycoprotein (MAG) is likely to be a growth inhibitor since the central nervous system supports little nerve growth compared with the peripheral nervous system. If MAG is turned off, then it may be possible for the central nervous system to grow new nerve cells, repairing damage such as occurs in spinal cord injuries.
22. Students' answers will vary depending on their research.
    Some possible new forms of research include
    - gene therapy
    - investigating the role of mitochondria
    - investigating the role of folic acid; some studies have linked a deficiency of folic acid with Parkinson's disease
    - a virus that may cause Parkinson's disease. The virus, combined with a genetic makeup that makes a person susceptible to Parkinson's, may be the reason that Parkinson's disease tends to run in families.
23. If huperzine A inhibits the action of cholinesterase, then acetylcholine will not be destroyed as quickly in the synapse, which is the cause of Alzheimer's disease.

    Many Western scientists do not value the medicinal effects of foods on human disease. Since foods produce different quantities of nutrients that may be considered medicinal, their levels may not be adequate to treat disease or may not treat disease as effectively as modern medicine.

    If its action can be proven, scientists will attempt to isolate the chemical produced and manufacture a synthetic version in the laboratory.

24. (a) If the spinal cord is injured, the transmission of impulses from sensory neurons to association (interneurons) may be impaired. This would result in the loss of sensation in the brain.
    (b) Id proteins stimulate the growth of cancer cells. If they can also be used to stimulate the regrowth of neurons, the symptoms of spinal cord injuries may be reduced or reversed.
    (c) Association neurons do not enter mitosis often. The Id protein acts on the axon of the neuron, whereas the cell body is unaffected, resulting in no change to the rate of mitosis.
25. A local anaesthetic works by affecting the threshold levels and depolarization of sensory and motor neurons of the peripheral nervous systems, temporarily preventing any action potentials. One cannot "feel" the part of the body that has received a local anaesthetic. Because a general anaesthetic must "turn off" the whole body, these agents act directly on the brain and generally involve a loss of consciousness. Their exact mechanism is not known.

CHAPTER 14 The Senses

Starting Points

(Page 444)

See the Teacher's Resource, pages 482–483, for examples of answers that show common misconceptions.

1. (a) The brain would interpret a loud sound as a bright light or other image.
   (b) It may cause a different visual interpretation, since visual information is stored in different areas of the occipital lobe.
2. (a) Neurons are no longer responding to the impulse.
   (b) It will allow the neurons to detect different odours and prevent the neurons from becoming overstimulated.
3. Lips > Fingertips > Face > Back of Neck > Shoulder > Palm of Hand
   Depending on the tissue's function, more sensory neurons may be required, making that area more sensitive to stimulation.

Exploration: Detecting Temperature Changes

(Page 445)

(a) The hand in cold water will feel hot, and the hand in hot water will feel cold.
(b) Your heat receptors have been overstimulated during a warm shower. When you step out, they do not respond to the lower temperature, and your cold receptors do.
(c) The frog placed in hot water will experience the stimulation of many heat receptors all at once. Slowly elevating the temperature will allow these receptors to respond more gradually.

14.1 SENSORY INFORMATION

Investigation 14.1: Mapping Sensory Receptors

(Pages 462–463)

Purpose

To determine what areas of the body contain the greatest concentration of sensory receptors, what the role of hot and cold receptors are, and how they function

Problem

What areas of the body contain the greatest concentration of sensory receptors? What is the role of hot and cold receptors, and how do they function?

